

PATENT SPECIFICATION
DRAWINGS ATTACHED

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COMPLETE SPECIFICATION

Improvements in or relating to Apparatus for Separating
Metallic Substances from Non-Metallic Material

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5 Hoechst, Germany, do hereby declare the
invention, for which we pray that a patent
may be granted to us, and the method by
which it is to be performed, to be parti-
cularly described in and by the following
statement:—

10 This invention relates to apparatus for
separating metallic substances from moving
non-metallic material. In particular the appa-
ratus may be used for separating metallic
15 substances from moving non-metallic material
which is to be ground.

One known form of such apparatus com-
prises a vertical shaft around the upper por-
tion of which is wound a coil connected to
20 a high-frequency vacuum-tube oscillator.
Material to be ground is fed into the top
of the shaft, passes through the high-
frequency alternating field of the oscillator
coil and emerges at the bottom of the shaft.
25 The lower end of the shaft has a deflecting
flap actuable by an amplifier to deflect
material from passing to the grinding appa-
ratus. The amplifier comprises rectifying and
differentiating means and includes compo-
30 nents having time constants corresponding to
the time taken for material to pass through
the coil and reach the deflecting flap.

When any metallic substance, whether
ferro-magnetic or not, which may be present
35 in the material to be ground, passes through
the oscillator coil, the amplitude and fre-
quency of the oscillations generated by the
oscillator are modified and an impulse-like
alteration of the anode current of the oscil-
40 lator tube is caused. This alteration in anode
current results in a transient voltage which

is rectified and differentiated in the amplifier
and the flap at the bottom of the shaft is
actuated to deflect material from passing to
the grinding apparatus. The amplifier compo-
45 nents having time-constants corresponding
to the time taken for material to pass
through the oscillator coil and reach the
deflecting flap, delay actuation of the flap
so that only that portion of the material
50 passing through the oscillator coil which
results in a substantial modification of the
amplitude and frequency of oscillation of the
oscillator is deflected at the lower end of
the shaft. When metallic substance has ceased
55 to pass through the oscillator coil the de-
flecting flap, after the appropriate delay,
returns to its normal unoperated position
and material again passes to the grinding
apparatus.

60 A typical oscillogram of the transient volt-
age referred to above, and produced in the
apparatus just described, when a metallic
substance passes through the oscillator coil,
is illustrated in Fig 1 of the accompanying
65 drawings which shows the voltage after am-
plification and delay. The transient impulse
comprises a fundamental oscillation having a
frequency lower than 50 c/s together with
various harmonic oscillations, the amplified
70 pulse shown in Fig. 1 having been lengthened
by about twenty times. A 50 c/s oscillation
represents a large portion of the impulse and
when the impulse is amplified any mains dis-
75 turbing voltage of 50c/s induced in the
oscillator coil will also be amplified. A dis-
advantage of this form of apparatus is that
compensation in the amplifier of this 50 c/s
disturbing voltage weakens the transient im-
80 pulse resulting from passage of a metallic
substance through the oscillator coil. Other
high frequency voltages introduced via the

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oscillator coil can be filtered out in the amplifier since their frequency is substantially higher than that of the transient voltage resulting from passage of metallic material through the oscillator coil.

The passage of a large batch of non-metallic material through the coil can also produce a transient voltage so that this form of apparatus has a further disadvantage in that the deflecting flap is liable to be actuated by non-metallic material.

The present invention provides apparatus for separating metallic substances from moving non-metallic material which does not have these disadvantages. The apparatus comprises a plurality of shafts disposed side-by-side and through which, in use of the apparatus, material passes, a coil wound around one shaft being counter-connected with any spaced apart in an axial direction from a coil wound around an adjacent shaft, the coils forming part of a high-frequency oscillator circuit, and operatively associated with the oscillator an amplifier for actuation of a device for deflecting the normal flow of material through the shafts, the amplifier including rectifying and differentiating means and including components having a time constant corresponding to the time taken by material to pass through a coil and reach the deflecting device, the arrangement being such that only passage of a metallic substance through the coils results in actuation of the deflecting device.

When the apparatus comprises more than two shafts with coils wound around them, then the coils are counterconnected in pairs. In this way any external disturbing voltage induced in the coils is balanced out without the high frequency field of the oscillator being weakened. The coils may be wound in the same sense around the shafts and the head end of the first coil of a pair connected to the tail end of the second coil of the pair and, conversely, the tail end of the first coil of the pair connected to the head end of the second coil of the pair. This results in balancing out of any external disturbing field.

Also in this apparatus, the material is distributed between the shafts and since the coils on the shafts are spaced apart in an axial direction any transient impulses formed by batch wise introduction of non-metallic material into the apparatus are produced one after the other with respect to time. The amplitude of each of these impulses is substantially smaller than the amplitude of the impulse that is produced if the whole batch of material is passed through one shaft, and the deflecting flap is therefore not actuated. Advantageously the coils of each pair of shafts are spaced apart by a distance of at least the width of a coil.

An example of apparatus embodying the

invention will be described in greater detail with reference to the accompanying drawing in which:—

Fig. 2 shows the apparatus in a diagrammatic manner, and

Fig. 3 shows a portion of Fig. 2 on an enlarged scale, magnetic fields associated with oscillator coils forming part of the apparatus being indicated.

The apparatus comprises two shafts 2, 2' located side-by-side and having a common inlet 1 for introduction of material into the shafts 2. Two coils 3 and 4 are wound around the respective shafts 2 and 2', the coils forming part of a high-frequency oscillator 5. The coils 3 and 4 are wound around the shafts 2 and 2' in the same sense, upper and lower ends of coil 3 being connected to the lower and upper ends respectively of coil 4, as seen in the Figure. The coils 3 and 4 are spaced apart in an axial direction on the shafts 2 and 2', by a distance of at least the width of a coil. Coupled to the oscillator 5 is an amplifier (not shown) connected to means for actuating a deflecting device (not shown) arranged at the outlet of the shafts 2 and 2' and which device serves, when actuated, to deflect the normal flow of material from the outlet. The amplifier includes rectifying and differentiating circuits and includes also components having a time constant equal to the time taken for material to pass through one of the coils 3 or 4 and reach the deflecting device.

High-frequency fields are indicated at 6 and 7 Fig. 3. The coils 3 and 4 have equal dimensions and comprise equal numbers of turns. Thus, in use of the apparatus, the voltages U1—U2 and U3—U4 due to an external field, e.g. due to an adjacent 50 c/s power supply, are equal in magnitude and opposite in phase and therefore cancel each other out.

Since the coils 3 and 4 are spaced apart in an axial direction the transient impulses induced in the coils due to passage of a metallic substance through the coils will not cancel each other out. The transient current fed to the amplifier from the oscillator will in these circumstances comprise two consecutive impulses having opposite phases.

After rectification and differentiation of the transient impulses in the amplifier, if the impulses have a sufficient amplitude, as determined by the components in the amplifier, then the deflecting device is actuated after the appropriate delay and the material passing through the outlet of shafts 2 and 2' is deflected until passage through the coils 3 and 4 of material containing metallic substance ceases.

WHAT WE CLAIM IS:—

1. Apparatus for separating metallic substances from moving non-metallic material,

- the apparatus comprising a plurality of shafts disposed side-by-side and through which, in use of the apparatus, material passes, a coil wound around one shaft being counter-connected with and spaced apart in an axial direction from a coil wound around an adjacent shaft, the coils forming part of a high-frequency oscillator circuit, and operatively associated with the oscillator an amplifier for actuation of a device for deflecting the normal flow of material through the shafts, the amplifier including rectifying and differentiating means and including components having a time constant corresponding to the time taken by material to pass through a coil and reach the deflecting device, the arrangement being such that only passage of a metallic substance through the coils results in actuation of the deflecting device.
- 5 2. Apparatus as claimed in claim 1 in which each coil is spaced apart, in an axial direction, from the coil with which it is counter-connected by a distance of at least the width of a coil. 20
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